# Outline of Ecology
**January 2, 2012**

**Contents**



**Note**: To look up references, see the Consciousness Bibliography, listing 10,000 books and articles, with full journal and author names, available in text and PDF file formats at http://www.outline-of-knowledge.info/Consciousness_Bibliography/index.html.

## BIOL>Ecology

### ecology

Biology {ecology}| can be about environments, populations, and communities. Biological seasons are winter, early spring, late spring, early summer, late summer, and fall.

## BIOL>Ecology>Conservation

### conservation in ecology

Active resource or geographic-area management {conservation, ecology} involves obtaining continual and similar yields at each cycle, by balancing harvesting and renewing and by assessing production, recreation, and aesthetic factors.

### compartmentalization

People can use resources or geographic areas for several purposes {multiple-use} or for one purpose per place {compartmentalization}. Compartmentalization typically is more efficient than multiple-use.

## BIOL>Ecology>Community

**community of life**

In regions {community, ecology}, all life interrelates. Species relations include competition.

**parts**

Communities have producers, consumers, decomposers, and inorganic materials. Communities organize around dominant species. Communities typically maintain species numbers.

**patterns**

Communities have food-chain patterns among producers, consumers, and decomposers. Communities have reproductive patterns, such as cloning or having offspring. Communities have social patterns, such as herds, colonies, or slaves. Communities can have population periodicity. Communities can have segregated populations in different regions. Communities can have different populations at different heights.

**species relations**

Species relations include amensalism, commensalism, mutualism, neutralism, proto-cooperation, parasitism, and symbiosis. Species can eat other species {predation, community}. Two species can need same territory or food {competition, community}.

**altruism in ecology**

Organisms can help other organisms survive and reproduce {altruism, ecology}|, though organisms typically compete.

**causes**

Altruism can happen if organisms need each other to survive or reproduce. Altruism can happen if organisms share genes. Altruism varies directly with percentage of shared genes or contribution to survival or reproduction.

**kinship**

Humans practice altruism unconsciously in families and kinship groups. Outside kinship groups, conscious altruism typically depends on reciprocation, and people remember past actions and decide whether to be altruistic or competitive.

**comparison**

Interactions among evolutionary levels and among evolution mechanisms can account for altruism, cooperation, social organization, and neutrality, which seemingly contradict natural selection.

**diversity of species**

Species number and range {diversity, ecology}| increase with fewer organisms, greater diversity, more niches, fewer predators, and less harsh environments. Communities with more species diversity are more stable.

**territoriality of animals**

Males can define geographic areas {territoriality, ecology}| that they can defend against other same-species males. Territory is typically just large enough to provide needed food.

**methods**

Animals keep territory by defense or advertisement. The larger or resident male typically wins contests over territory, mostly by bluffing.

**effects**

Territoriality prevents food shortage by causing individual selection for food supply. Territoriality prevents overpopulation by maintaining constant population density. Territoriality reduces competition and conserves energy by preventing more numerous contests and competitions. It is typically more efficient than unregulated competition for food. Individuals holding territory tolerate neighboring territory holders, to save energy, by habituating through frequent contact and communication.

**evolution**

Nereid worms have territoriality.

## BIOL>Ecology>Community>Food Chain

**food chain**

Larger consumers eat smaller consumers, who eat producers or decayed matter {food chain}|. Producer number and mass must be larger than consumer number and mass. Food chains can start with microorganisms grazing on decayed matter. Visible organisms eat zooplankton. Larger organisms are at food-chain top.

Smaller organisms have higher metabolism per gram. Plants use 3% of received light. Animals use 5% to 10% of food.

**trophic level**

Food chains or food webs have hierarchies of predatory levels {trophic level}, by organism sizes. For example, ocean algae phytoplankton are at Level 1. Krill zooplankton are at Level 2. Haddock, sardine, anchovy, and herring are at Level 3. Whiting, snapper, and halibut are at Level 4. Cod and tuna are at Level 5. Saithe are at Level 6. Higher levels grow more slowly.

**BIOL>Ecology>Community>Food Chain>Organism Types**

**detritus**

Dead organisms {detritus}| are 30% of ocean food and 90% of forest food.

**holozoic**

Consumer organisms {holozoic} can digest food.

**herbivore**

Animals can be plant eaters {herbivore}|.

**carnivore in food chain**

Animals can be meat eaters {carnivore, food chain}|.

**omnivore**

Animals {omnivore}| can eat all food types. Omnivores have the most and the most-varied activities.

**BIOL>Ecology>Community>Food Chain>Organism Types>Troph**

**saprotroph**

Bacteria and other microconsumers {saprotroph} {saprophytic organism} can absorb dead and decaying organic matter.

**autotroph**

Producer organisms {autotroph} can synthesize food from inorganic materials, by photosynthesis or chemosynthesis.

**heterotroph**

Consumer organisms {heterotroph} can eat autotrophs or dead organic matter.

**osmotroph**

Bacteria and other microconsumers {osmotroph} can intake nutrients from water.

**phagotroph**

Predators and macroconsumers {phagotroph} eat other living organisms.

**BIOL>Ecology>Community>Food Chain>Organism Types>Aerobe**

**aerobe**

Organisms {aerobe}| can use oxygen as electron acceptors to oxidize other molecules, to get energy.

**anaerobe**

Organisms {anaerobe}| can use sugars, not oxygen, to get energy.

**facultative aerobe**

Organisms {facultative aerobe} can use either oxygen or sugars but prefer oxygen to get energy.

**obligate anaerobe**
Organisms {obligate anaerobe} can use sugars to get energy.

**BIOL>Ecology>Community>Food Chain>Organism Types>Ocean**

**benthos**
Ocean organisms {benthos} can be bottom dwellers.

**nekton**
Ocean organisms {nekton} can be swimming animals.

**pelagic**
Ocean organisms {pelagic}| can be open-water dwellers.

**vertical migration**
In oceans, animal masses in deep scattering layer (DSL) rise at night and fall by day {vertical migration}|.

**BIOL>Ecology>Community>Food Chain>Organism Types>Ocean>Plankton**

**plankton**
Organisms {plankton}| can float.

**phytoplankton**
Plankton {phytoplankton} can be floating plants.

**zooplankton**
Plankton {zooplankton} can be miniscule animals.

**BIOL>Ecology>Community>Population**

**population of community**
For each species, communities have numbers {population, ecology} of individuals. Populations have relative numbers at each age range {age distribution}.

**carrying capacity**
Population-change rate depends on growth rate, population, and available resources {carrying capacity, population}|: dN / dt = r * N * (1 - N/K), where N is total population, r is growth rate, and K is maximum possible population.

**deme**
Populations {deme}| {genetic population} can be one interbreeding species.

**dispersal of population**
Regions have average distances {dispersal}| {dispersion, distance} among animals. Emigration, immigration, and migration rates depend on mobility and terrain. Populations disperse until reaching barriers.

**population density ecology**
Populations have numbers of individuals per area {population density, ecology}.
**effects**
Denser populations have more pathogens, parasites, and competition. Infanticide, cannibalism, competition, disease, genetic change, breeding-behavior changes, and food-supply changes can increase.
**regulation**
Species have population-density-dependent population controls, to avoid extinction. Controls can reduce population if density increases: increased predation by predators, decreased food supply, increased territoriality, increased emigration, reduced hormones from increased stress, reduced fertility, and more inhibited development. Low-density

populations and stable populations respond quicker to population-density-dependent parameters. High-density and unstable populations respond slower to density-dependent parameters and respond at higher thresholds.

**vertical stratification**

In environments with different heights, such as rain forests, populations differ at different heights {vertical stratification}|.

**BIOL>Ecology>Community>Population>Growth**

**population growth**

Populations can grow {population growth} exponentially (Malthus). At time t, number n is growth rate r times number n at previous time t - 1: $n(t) = r * n(t - 1)$.

**curve**

Population growth often has S-shaped curves, with slow increase at first, then exponential growth, and then flattening rate when approaching environmental capacity. Populations typically increase until stopped by environmental shortages.

**cycles**

Lemming and snowshoe-hare populations have growth and decline cycles. Perhaps, crowding and competition stresses cause cycles.

**Allee principle**

Undercrowding can be population-limiting factor {Allée's principle} {Allée principle}.

**logistic difference equation**

To account for death from food lacks, predators, and diseases, current number n(t) is growth rate r times previous number n(t - 1) times one minus previous number {logistic difference equation}: $n(t) = r * n(t - 1) * (1 - n(t - 1))$.

**BIOL>Ecology>Community>Population>Growth>Potential**

**biotic potential**

If environment has no limiting food, predators, or disease factors, population-increase rate {biotic potential} is maximum.

**reproductive potential**

If no limiting food, predators, or disease factors affect reproduction, population-increase rate {reproductive potential}|is maximum.

**BIOL>Ecology>Community>Population>Growth>Rate**

**birth rate**

Populations have births per 1000 people each year {birth rate}|.

**death rate**

Populations have deaths per 1000 people each year {death rate}|.

**survival rate**

Populations have number who survive per 1000 people each year {survival rate}|, which is opposite of death rate.

**BIOL>Ecology>Community>Society**

**society of life**

Social systems {society, ecology} have evolved in colonial invertebrates, social insects, non-human mammals, and humans. Societal animals occupy territory, cooperate, communicate using 10 to 100 basic signals, recognize group members, use kinship for social structure and socialization, and divide labor. Altruism, cohesiveness, and cooperativeness decline among higher phyla, because more individualism emerges. Group behavior reduces competition, conserves energy, prevents overcrowding, and prevents food shortage. Population members typically live in small groups, to survive better.

**effects**

Social systems can preserve genes, because groups have better foraging and self-defense. Effects differ depending on society size. Small colonies survive better than large colonies, and individuals survive better in small colonies. Food shortages happen more often in small groups, especially in mammalian societies. Smaller groups tend to diversify habitat more. Males and females differ more in smaller groups. Polygamy, strong sexual selection, and inbreeding are typical of small groups. In small and large groups, females concentrate on food and nests, but males concentrate on females.

**social change**

Social organization is variable and labile. Small environment, individual-behavior, or group-behavior changes can lead to great societal changes. Individual behaviors typically change first, followed by structural changes that enhance behavior.

**social factor**

Quantifiable societal factors {social factor} include group size, demography, cohesiveness, communication intensity, communication networks, closedness or openness, subgroup number, subgroup isolation, specialization, behavior coordination, information-flow rate, and percentage of social behavior compared to individual behavior. For example, society demography can define available cooperative behaviors. Demography also affects adaptability.

**sociobiology**

General-systems-theory extensions {sociobiology}| can depend on the idea that organisms exist to carry and reproduce genes. To successfully transmit genes to next generations requires optimally mixing personal survival, reproduction, and altruism. Emotions evolved to preserve optimum factor balance. Societies operate using principles at levels higher than, but emerging from, individual biochemistry, structures, and processes.

**BIOL>Ecology>Community>Society>Behavior**

**social behavior**

Behavior {social behavior, ecology} can depend on biochemical factors, structural factors, and population parameters. Behavioral changes require at least ten generations and typically more than twice that many. Behavioral-change rate depends on how directly behavior relates to survival and how easy learning is. Societal species tend to evolve more behaviors, easier learning, and more learning abilities. Social species have traditions, tools, and play.

**behavior scale**

Societies have available-behavior ranges {behavior scale}|, because species competition forces species to occupy more than preferred ecological niches. Behavior scales are adaptations. Behaviors typically have more than one use. Behavior scales depend on population density and other group parameters. Society evolution tends to make behaviors converge.

**social distance**

Species have minimum allowed distance {social distance}| between two individuals. In humans, social distance is one meter.

**social drift**

Individual behavior changes can cause random group-behavior changes over time {social drift}.

**BIOL>Ecology>Community>Society>Kinds**

**colonial invertebrate**

Invertebrates {colonial invertebrate}| can have cells {zooid} that aggregate to form organisms, in which cells can specialize. Zooids act like specialized organs. In hydrozooid colonies, ectoderm cells recognize each other using cell-surface proteins from histocompatibility genes. Hydrozooid colonies have nerve-cell zooids. Colonial-invertebrate cells communicate using chemical signals. Colonial invertebrates reproduce by budding. Colonies can form within colonies.

**social insect**

Insect societies {social insect}| have members that share the same gene alleles. Social insects have roles, but insects can modify roles. Signals among insects communicate food sources and coordinate tasks.

**social vertebrate**

Vertebrate societies {social vertebrate} are typically bands or cliques, rather than large groups. Individuals have less genetic similarity, practice less altruism, are more aggressive, have little cooperation, and have learning and traditions.

**BIOL>Ecology>Community>Species Relations**

**amensalism**

One species can harm another species, but second species does not affect first species {amensalism}|.

**commensalism**

One species can benefit another species, but second species does not affect first species {commensalism}|. Cardinal fish live in conches, shrimp live in sponge pores, Nomeus live in Portuguese man-o'-war tentacles, and hermit crabs use other shells. Epiphyte plants live on other plants but get food from air.

**mutualism**

Two species can have close association for survival {mutualism}|.

**neutralism**

Two species can have no relations {neutralism}|.

**parasitism**

One species {parasite} {parasitism}| can live in or on, obtain nourishment from, and harm another species. Fish lice, hydroids, lamprey eels, and barnacles harm hosts. Mammals have no parasitism.

**proto-cooperation**

Two species can help each other get food {proto-cooperation}|.

**symbiosis**

Two species can live in close association {symbiosis}|. Crabs carry sea anemones, clownfish live in poisonous anemone tentacles, remoras use suction cups to hold onto sharks, pilot fish swim with sharks, and goby fish clean other fish. Symbiosis is more common in insects and other species without personality.

**BIOL>Ecology>Community>Succession**

**succession of life**

In geographic areas, plant and animal populations undergo typical change sequences {succession, species}| {serial stages} in response to fires, floods, volcano eruptions, tornadoes, hurricanes, diseases, insect infestations, harvesting, and clearing. Succession typically results in more biomass, more diversity, and more stability. Sequences end in climax communities.

**fire**

After forest fires, less common species found only in older forests are no longer present. Species sensitive to fire decrease greatly and only slowly increase. Other species increase after fire and dominate, then decrease.

Native species often increase. Exotic species invade. Grass {graminoid plant} cover increases.

Where fires happen every dry season, as in savannah woodlands, monsoon forests, and tropical pine forests, trees have thick bark, make seeds that can grow in fire-damaged regions, develop biochemical mechanisms to heal fire scars, and can re-sprout.

**factors**

Succession patterns depend on biome, land elevation, forest or grassland terrain, seed-dispersal mechanisms, winds, nearby species, time between catastrophes, and human effects. Succession patterns differ by catastrophe type.

**climax community**

Succession sequences end in stable communities {climax community}| with stable populations in stable environments.

**BIOL>Ecology>Ecosystem**

**ecosystem**

Earth has different physical regions {ecosystem}|, closely related to climate. Ecosystems include broadleaf forest, coniferous forest, desert, savanna, prairie, sclerophyll woodland and shrub, swamp, tropical forest, tropical rain forest, steppe, and tundra. Biological systems have climates, inorganic matter, organic matter, producers, and consumers. Cities are warmer, less humid, cloudier, foggier, rainier, snowier, and less sunshiny, and have less ultraviolet light, than countryside.

**biogeographic realm**

Ecosystems have regions {biogeographic realm}. Palearctic includes Europe, Russia, north China, Japan, and Iceland. Nearctic includes Greenland, Canada, and USA. Palearctic and Nearctic together are Holarctic. Neotropical includes Mexico, Central America, South America, and West Indies. Ethiopian includes Africa south of Sahara Desert. Oriental includes India, Indochina, Malay Peninsula, south China, and East Indies. Australian includes Australia, New Zealand, New Guinea, and East Indies.

**biogeography**

Vertebrate species typically have ranges {biogeography} smaller than large USA states. Common birds, such as cowbirds, grackles, and cardinals, have larger ranges. Only species with large ranges are not rare. Most vertebrate species are rare.

State-size regions can have few, medium, or many species, depending on climate and resources. Tropical areas have 100 times more species than arctic areas. Areas with many species have species with large ranges. Areas with few species have species with small ranges.

**biosphere**

The world {biosphere}| includes many different environments for living things.

**cline**

Species can have gradual anatomy and physiology changes throughout gradually changing geographic areas {cline}|.

**ecological niche**

Species have roles {ecological niche}| {niche, ecology} in ecosystems.

**habitat**

Species inhabit environments {habitat}|.

**limnology**

rivers and coasts {limnology}|.

**BIOL>Ecology>Ecosystem>Bione**

**bione**

Different communities live in different geographic zones {bione}|.

**forest**

Forest biones include broad-leaved evergreen subtropical forest, chaparral, coniferous forest, deciduous forest, and tropical rain forest.

**ocean**

Sea biones include neritic zone, littoral zone, continental shelf below low tide, oceanic zone, euphotic zone, bathyal zone, and abyssal zone.

**other**

Other biones include desert, grassland, tundra, snow and ice, estuary, marsh, running water, littoral, limnetic zone, standing water, and deep water.

**changes**

Biones gradually change or cycle. Sahara desert expands and contracts in a 30-year cycle.

**ecotone**

More species and higher population densities are at bione boundaries {ecotone}.

**BIOL>Ecology>Ecosystem>Bione>Land**

**prairie as plain**

dry bushy plains {prairie}|.

**savanna**

wide dry grassy plains {savanna}|.

**BIOL>Ecology>Ecosystem>Bione>Water**

**tide pool**

Animals can live between low-tide and high-tide lines {tide pool}|: sea anemone, sculpin fish, hermit crab, chiton, ochre star, barnacle, limpet, mussel, and turban snail. Algae and other plants are in tide pools. Sea urchin, abalone, sunflower star, bat star, and giant sea anemone live below low-tide line.

**deep scattering layer**

In ocean, animal masses {deep scattering layer} (DSL) rise at night and fall by day, in vertical migration.

**BIOL>Ecology>Ecosystem>Bione>Water>Ocean Zones**

**oceanic zone**

Ocean zones {oceanic zone} include bathyal and abyssal zones.

**abyssal zone**

Oceanic zones {abyssal zone} can be below 2000 meters.

**bathyal zone**

Oceanic zones {bathyal zone} can be from surface down to 2000 meters.

**euphotic zone**

Oceanic zones {euphotic zone} can have light.

**limnetic zone**

ocean coasts and river mouths {limnetic zone}.

**littoral zone**

Continental shelf {littoral zone} can be between tides.

**neritic zone**

Continental shelf {neritic zone} can be above high tide.

**BIOL>Ecology>Ecosystem>Bione>Water>Swamp**

**swamp as marsh**

vegetation-rich still water {swamp}|.

**ignis fatuus**

Swamps can have phosphorescent light {ignis fatuus}| {will of the wisp} {friar's lantern}, from spontaneous methane combustion.

**BIOL>Ecology>Ecosystem>Ecological Cycle**

**ecological cycle**

Nutrients undergo recurring use and storage {ecological cycle}. Carbon atoms circulate between organism organic molecules and environment carbon dioxide and calcium carbonate {carbon cycle, ecology}. Nitrogen atoms circulate between organism proteins and environment nitrogen gas, nitrates, and nitrites {nitrogen cycle, ecology}. Phosphorus atoms circulate between organism organic phosphates and environment mineral phosphates {phosphorus cycle}. Water molecules circulate between organism cells and intracellular fluids and environment oceans, clouds, and fresh water {water cycle, ecology}.

**BIOL>Ecology>Ecosystem>Ecological Cycle>Pool**

**exchange pool**
Nutrients leave and return {cycling pool} {exchange pool} from and to reservoir pools. Detritus and excrement recycle nutrients.

**reservoir pool**
Nutrients are in ocean, atmosphere, and crust {reservoir pool}.

**BIOL>Ecology>Ecosystem>Ecological Cycle>Energy**

**energy cycle in ecology**
Energy circulates between organism organic-molecule bonds and environment heat and sunlight {energy cycle, ecology}. Ecosystems have energy flows.

**Liebig law of the minimum**
If energy and material inflow balances energy and material outflow, the minimal material limits species-organism number or size {Liebig's law of the minimum} {Liebig law of the minimum}.

**BIOL>Ecology>Ecosystem>Environmental Factor**

**environmental factor**
Physical factors {environmental factor} can directly affect organism growth: temperature, light, water, dissolved gases, trace elements, water flow, soil acidity, soil porosity, soil depth, fire hazard, and organic nutrients. Tropical plants have high carbohydrate percentage.
**land**
Light, temperature, and rainfall are important land environmental factors.
**water**
Light, temperature, and salinity are important ocean environmental factors. Oxygen content is important environmental factor in fresh water.
**temperature**
Growth is typically faster with varying temperature. Water has less temperature variation than land or air.
**light**
Ultraviolet light kills unprotected cells, so organisms must filter light. Sunlight inhibits protein synthesis.

**Shelford law of tolerance**
Organism absence from environments or failure to live in new environments depends on limiting environmental factors organism can tolerate {Shelford's law of tolerance} {Shelford law of tolerance}.

**BIOL>Ecology>Ecosystem>Range**

**range of species**
Species occupy geographic areas {range, species} {range of tolerance} {tolerance range} with temperature, elevation, water supply, and sunlight extremes. Range is lower for embryonic and immature life stages and during adult reproductive periods.

**eury range**
Range can be wide {eury range}. Eury-organisms have wider distribution than steno-organisms.

**steno range**

Range can be narrow {steno range}.

**BIOL>Ecology>Pollution**

**pollution**

Polluting {pollution}| wastes resources, uses unneeded things, and fails to clean up wastes. Minimizing pollution has high value, because recovery cost is high and time is long.

**biodegradable**

Bacteria or natural reactions can break down waste products, radiating materials, and chemical residues {biodegradable}|, so they can disperse into environment. Biodegradable pollutants discharge at rate that environment can disperse or absorb them. Non-degradable pollutants can go into secure containers.

**BIOL>Ecology>Pollution>Kinds**

**air pollution**

Vehicles and industry add most dirt and chemicals to air {air pollution}. Air pollution can disperse in open geographies. Air pollution can concentrate in enclosed geographies.

**eutrophication**

Water can have too many nutrients, which allow algae and floating phytoplankton to grow. They block sunlight from reaching deeper into water. When they die, they fall to bottom. Bacteria use oxygen to decompose them, leaving oxygen-depleted water {eutrophication}|.

**noise pollution**

Major noise sources {noise pollution} are motorcycles, trucks, cars, airplanes near airports, and household appliances.

**radiation pollution**

Radioactivity comes from natural sources and nuclear wastes {radiation pollution}. Plants and fast-growing cells, such as in children, are most sensitive to radiation. Animals with poor nutrition are more sensitive to radiation.

**smog**

Car exhaust and industrial smoke make photochemical products {smog}|.

**solid waste**

Households, mines, farms, and industries make sewage, construction waste, industrial by-products, used consumer goods, and garbage {solid waste}, including paper, glass, metal, and leaves.

**thermal pollution**

Environmental added heat {thermal pollution} harms reproduction if very hot, increases susceptibility to toxins, and reduces water oxygen level by encouraging blue-green algae growth.

**water pollution**

Industry and sewage add dirt and chemicals to water {water pollution}.